R.A.S. Reference No.	Subject.	Photograph by
1	Total Solar Eclipse, 1889 January 1	W. H. Pickering
2	Total Solar Eclipse, 1893 April 16	J. M. Schaeberle
3	Total Solar Eclipse, 1886 August 29	A. Schuster
4	Nebulæ in the Pleiades	Isaac Roberts
5	Nebula M. 74 Piscium	Isaac Roberts
6	Great Nebula in Orion	Isaac Roberts
7	Milky Way near Messier II.	E. E. Barnard
8	Milky Way near Cluster in Perseus	E. E. Barnard
9	Comet *c* 1893 IV. (Brooks)	E. E. Barnard
10	Comet *a* 1892 I. (Swift)	E. E. Barnard
11	Nebula about η Argûs	David Gill
12	Portion of Moon (Hyginus-Albategnius)	MM. Lœwy and Puiseux

Arrangements are also being made for the supply of lantern slides prepared from the photographs in the possession of the Society. Further particulars respecting these will be issued as soon as the arrangements are complete.

A Determination of the Mean N.P.D. 1790 January 0, of γ Draconis from Observations made at Oxford by Dr. Hornsby.

By E. J. Stone, M.A., F.R.S., Radcliffe Observer.

The Radcliffe Observatory, Oxford, was built about the year 1771, by the Radcliffe Trustees at the request of the University authorities, and furnished with the best instruments available at the time.

The equipment for the meridian observations consisted of two brass quadrants of 8 feet radius, a zenith sector of 12 feet focal length, and a transit instrument with an object glass of 4 inches. The mechanical parts of these instruments, and the divisions, were the work of the celebrated mechanician John Bird, and the optical work was by Dollond. There was no observatory in the world better equipped with meridian instruments than the Oxford Observatory at its foundation.

The quadrant and transit observations made by Dr. Hornsby in the year 1774, and in many subsequent years, were copied by him into books; but the papers generally are in great confusion. Dr. Hornsby reduced some selected observations for special purposes; but the observations have never been regularly reduced, nor, so far as I can find, have they been published in any form which would render them available for the use of astronomers.

The completion of the "Radcliffe Catalogue of 6,424 Stars for 1890" has afforded me the necessary leisure to take into con-

sideration the desirability of reducing some of the old observations made at the observatory.

An examination and partial reduction of the observations made with the quadrant and transit in the year 1774 have satisfied me that the observations are of very considerable accuracy.

I have therefore determined to completely reduce the observations of the year 1774 as a test of the expediency of a more extended reduction of these back observations. There are many considerations which appear to render these reductions desirable. We are relying for our determinations of many of the more important constants of astronomy upon the freedom of the observations made by Bradley at Greenwich, 1750–1762, from serious systematic errors; and our confidence is probably justifiable. But it was clearly shown by Le Verrier in his discussion of the solar observations that, when accurate meridian work was commenced at Paris about 1801, and at Königsberg about 1816, the results obtained were not in satisfactory agreement with the corresponding Greenwich results; and, if the Greenwich results were not then free from serious systematic errors, the question naturally arises, Up to what epoch are we justified in accepting them as free from such errors?

It appeared to me that some light might probably be thrown upon this question by a reduction of the observations made at Oxford about 1774; and, as an additional inducement to undertake the labour of these reductions, I find that a considerable number of observations of the Moon were made at Oxford about this period, which is a critical one in the lunar theory from the magnitude at that time of the doubtful theoretical inequality which Hansen has introduced in the construction of his Lunar Tables.

But as a preliminary step to the complete reduction of the quadrant observations, it has been thought desirable to examine the values of the zenith distances of *γ Draconis* at Oxford for the meridian transits which result from the zenith-sector observations; and the results thus obtained are given in the present paper.

It may be mentioned that the zenith-sector micrometer has two scales—one giving the number of completed revolutions up to eighteen, the other the divisions and decimal parts of a division—and that Bird cut the screw so that one revolution was very nearly equivalent to $27''$ of the sector arc. This equivalence was very nearly exact when the instrument was first mounted and adjusted by Bird, and it has been assumed to be exact by Hornsby in his reductions; but I have corrected the results for run whenever readings at consecutive three-minute divisions of the sector arc have been available.

I have also reduced all the observations with the values of the coefficients of aberration, nutation, and precession which are at present usually employed. A few sector observations were made in

1775 with a non-achromatic object glass: I have not at present reduced these observations. In 1777 an achromatic object glass by Dollond was mounted on the zenith sector, and a few observations were made in 1777 and 1778. I have reduced these observations. But during this period the observations were made with a direct eye-piece instead of with a far more convenient diagonal eye-piece first introduced in April, 1778. The desirability of measuring the star's ZD from two adjacent divisions of the sector arc was not apparently so fully recognised as was subsequently the case; the collimation error was unduly large; and there are no sufficient checks upon the constancy of the collimation error, sector east and west, for the observations which have to be combined. The line of collimation was considerably altered by Hornsby in 1778, when he introduced the diagonal eye-piece.

In the reduction of these sector observations it is necessary to assume that the line of collimation remains sensibly unchanged during the whole period for which the sector observations, east and west, are combined, and the only proof of this assumed constancy of the line of collimation is the agreement of the results thus obtained. It would have been more satisfactory if the zenith sector had been reversed oftener than was the case, but a combination of all the observations made, 1788–1791, shows that the changes of the line of collimation of the Oxford zenith sector must have been confined within small limits during this period; and the results thus obtained would, therefore, appear to be entitled to greater weight than those given by the observations 1777–1778, when the constancy of the line of collimation was more doubtful.

The latitude of the zenith sector is very nearly the same as that of the transit circle of the observatory; and if we assume the colatitude to be

$$38^\circ\ 14'\ 24''{\cdot}61,$$

and the proper motion of γ *Draconis* in N.P.D. to be $+0''{\cdot}028$, we deduce from the sector observations the following values for the mean N.P.D. 1790 January 0:—

	From Observations.	No. of Obs.	Weight.	Mean N.P.D.
	Sector East.			
1	1788 Oct. 7 to Dec. 31	13	10·5	$38^\circ\ 28'\ 50''{\cdot}92$
2	1789 Feb. 12 to Feb. 15	2	2	49·48
3	1791 Jan. 4 to Feb. 28	12	11	48·89
4	1791 Sept. 10 to Sept. 25	9	9	50·64
5	1791 Oct. 23 to Dec. 28	7	7	50·50
	Sector West.			
6	1789 Jan. 1 to Feb. 10	14	13·5	44·81
7	1790 Oct. 15 to Dec. 30	15	15	44·91
8	1791 Sept. 26 to Oct. 19	12	12	45·59

These separate results show that no great changes in the line of collimation took place between 1788 October 7 and 1791 December 28; and if we assume the collimation error to be sensibly constant for this period, we find for the mean collimation error, c, and the N.P.D. of γ *Draconis* the following values :—

Mean N.P.D. of γ *Draconis* 1790 Jan. 0 = 38° 28′ 47″·61 $\quad c = +2''{\cdot}52$

and the separate residuals, which include errors of observation and changes of the line of collimation from the mean line are—

	Sector East.		*West.*
1	+0″·79	6	−0″·21
2	−0·65	7	−0·18
3	−1·24	8	+0·50
4	+0·51		
5	+0·37		

The observations made, 1777–1778, lead to a larger result for the N.P.D., viz.

$$\frac{E+W}{2} = 38° \ 28' \ 50''{\cdot}44.$$

If we combined this result with that deduced from the observations, 1788–1791, with the full weight due to the number of observations, we should find

$$\text{N.P.D.} = 38° \ 28' \ 47''{\cdot}95.$$

But, for the reasons given, this is certainly allowing too much weight to the earlier observations. The N.P.D. of γ *Draconis* given by Dr. Auwers in his re-reduction of Bradley's observations brought up to 1790 January 0 is

$$38° \ 28' \ 48''{\cdot}34;$$

and this result appears to me to agree as closely as could have been expected, with the instruments available, with that found from the Oxford observations, 1788–1791 :—

$$38° \ 28' \ 47''{\cdot}61.$$

In the following reductions, when the run over 3′ has not been found from the observations, the adopted quantities have been put in brackets, and only half-weight has been given to these results.

Observations of γ Draconis with the Zenith Sector.

Date.	Division.	Reading of Micrometer For Division.	Reading of Micrometer For Star.	Nominal Seconds of Micrometer in Run over 3′.	Apparent Z.D. (Uncorrected for Refraction.)	Mean Z.D. for 1778 Jan. 0.
			Sector E.			
1777. Nov. 7	12	r d 3 21·9	r d 17 20·5	(180·0)	° ′ ″ 0 13 49·40	° ′ ″ 0 14 5·17
Dec. 16	12	10 4·5	5 17·5	179·7	0 14 2·20	5·91
	15	3 13·8				
27	12	8 9·0	3 15·5	180·8	7·92	7·27
	18	12 25·4				
29	12	13 0·0	8 5·5	179·6	9·79	8·41
	15	6 9·4				
1778. Jan. 21	12	8 0·5	2 22·5	(180·1)	19·92	10·58
22	12	15 10·5	10 6·2	180·3	19·07	9·41
	15	8 19·2				
Feb. 28	12	15 25·7	10 13·3	(182·0)	25·78	7·68
			Sector W.			
1778. Jan. 25	15	12 15·6	11 17·6	(181·8)	0 14 35·25	0 14 24·68
26	12	7 25·5	13 17·3	181·3	32·70	21·82
	15	14 17·8				
Feb. 13	12	7 14·0	13 16·9	181·9	43·18	27·64
	15	14 6·9				
14	12	3 23·2	9 23·2	181·3	40·84	25·08
	15	10 15·5				
17	15	3 18·7	3 1·0	(181·8)	42·48	26·12
23	15	9 1·0	8 12·3	(181·8)	44·46	27·06
25	12	7 3·8	13 9·0	182·6	44·82	27·12
	15	13 24·4				

Between 1778 Jan. 26 and Feb. 9 the sector was reversed from west to east and again brought back to position west; but no observations of γ *Draconis* were made in position east. The line of collimation would almost appear to have been shifted at the time by Dr. Hornsby, although I can find no notice of any such change.

1778 Feb. 28. The runs have been adopted from observations of α *Cygni* after the reversal from position west on Feb. 25.

A diagonal eye-piece was mounted on 1778 April 9; the observations before this period were made with a direct eye-piece.

Date.	Division.	Reading of Micrometer For Division.	Reading of Micrometer For Star.	Nominal Seconds of Micrometer in Run over 3′.	Apparent Z.D. (Uncorrected for Refraction.)	Mean Z.D. for Jan. 0.
			Sector E.			
1788.	′	r d	r d		° ′ ″	° ′ ″
Oct. 7	12	6 22·7	2 5·5	(182·5)	0 14 3·48	0 14 24·43
8	12	6 25·5	2 9·2	181·9	3·00	23·87
	15	0 5·6				
9	12	7 0·0	2 8·9	184·7	2·89	23·67
	15	0 4·3				
Dec. 4	12	5 15·8	0 11·1	(182·7)	17·64	26·52
12	12	11 12·5	6 2·1	(182·7)	23·25	29·36
15	12	11 10 8	6 3·6	(182·7)	20·10	25·20
17	12	17 10·1	12 5·9	182·8	17·07	21·50
	15	10 16·3				
21	12	17 12·5	12 4·5	181·3	21·97	24·68
	15	10 20·2				
*22	12	17 14·8	12 5·6	(181·5)	23·01	25·38
23	12	17 14·3	12 1·6	181·8	26·24	28·26
	15	10 21·5				
26	12	17 12·9	12 2 8	182·1	23·43	24·42
	15	10 19 8				
27	12	17 14·1	12 2·9	182·5	24·20	24·84
	15	10 20·6				
31	12	7·1	12 24·0	180·8	24·46	23·72
	15	11 15·3				
			Sector W.			
1789.						
Jan. 1	12	2 6·7	7 14·3	182·0	0 14 21·03	0 14 20·35
	15	8 26·7				
7	12	2 11·0	7 16·4	180·5	20·01	17·29
	15	9 2·5				
†11	12	2 11·8	7 17·2	173·7	25·49	21·45
	15	8 23·5				
13	12	2 5·4	7 17·3	182·9	24·57	19·87
	15	8 26·3				
16	12	2 4·4	7 14·7	182·4	23·39	17·74
	15	8 24 8				

* On 1788 Dec. 22 an observation was made with reference to division 18 for which the reading for the division was entered as $4^r\ 19^d{\cdot}0$. There is little doubt that the micrometer has been read backwards, and should be $4^r\ 8^d{\cdot}0$. It has been thought better to reject the observation than to make this conjectural alteration.

† 1789 Jan. 11. The observation is correctly reduced from Dr. Hornsby's MS., but the run appears unusually small.

Date.	Division.	Reading of Micrometer For Division.	Reading of Micrometer For Star.	Nominal Seconds of Micrometer in Run over 3′.	Apparent Z.D. (Uncorrected for Refraction.)	Mean Z.D. for Jan. 0.
1789.	′	r d	r d		° ′ ″	° ′ ″
Jan. 18	12	2 5·2	7 15·7	181·3	0 14 24·46	0 14 18·19
	15	8 24·5				
30	15	8 14·7	7 9·4	(181·5)	27·97	18·24
Feb. 1	12	1 22·3	7 11·6	181·5	30·05	19·80
	15	8 14·8				
2	12	1 21·4	7 10·2	182·8	28·49	17·98
	15	8 15·2				
4	12	1 23·9	7 15·4	183·0	30·98	19·97
	15	8 17·9				
5	12	1 24·6	7 17·2	183·4	31·73	20·48
	15	8 19·0				
8	12	1 24·0	7 16·7	183·2	32·00	20·06
	15	8 18·2				
9	12	1 25·0	7 17·9	183·1	32·28	20·12
	15	8 19·1				
10	12	1 24·8	7 18·3	183·5	32·53	20·16
	15	8 19·3				
		Sector E.				
1789.						
Feb. 12	12	8 7·5	2 10·9	182·3	0 14 36·60	0 14 23·81
	15	1 14·2				
15	12	8 3·9	2 5·3	183·2	37·80	24·43
	15	1 9·7				
		Sector W.				
1790.						
Oct. 15	12	9 9·7	13 17·1	181·6	0 13 54·38	0 14 19·43
	15	16 2·3				
16	12	9 13·7	13 21·1	181·0	54·77	19·69
	15	16 5·7				
Nov. 4	12	9 6·7	13 19·0	182·2	58·85	20·46
	15	15 26·9				
5	12	9 6·2	13 18·3	182·4	0 13 58·52	19·90
	15	15 26·6				
13	12	9 3·1	13 17·3	182·3	0 14 0·66	20·13
	15	15 23·4				
15	12	9 5·7	13 20·9	183·5	0·85	19·80
	15	15 27·2				
16	12	9 5·7	13 21·8	183·1	2·00	20·69
	15	15 26·8				

Date.	Division.	Reading of Micrometer For Division.	Reading of Micrometer For Star.	Nominal Seconds of Micrometer in Run over 3′.	Apparent Z.D. (Uncorrected for Refraction.)	Mean Z.D. for Jan. 0.
1790	′	r d	r d		° ′ ″	° ′ ″
Nov. 27	12	9 3·7	13 22·4	182·1	0 14 5·24	0 14 20·61
	15	15 23·8				
*Dec. 6	12	16 26·7	3 18·8	183·0	5·02	17·69
	15	5 20·7				
12	12	10 22·0	15 20·0	184·3	9·90	20·57
	15	17 17·3				
20	12	0 6·3	5 5·8	181·7	13·24	20·81
	15	6 26·0				
21	12	7 19·5	12 20·2	182·9	13·55	20·78
	15	14 13·4				
†22	12	17 24·4	4 23·9	181·4	13·46	20·34
	15	6 16·8				
28	12	0 0·0	5 4·1	181·9	17·65	22·43
	15	6 19·9				
30	12	7 3·2	12 7·3	182·7	17·04	21·12
	15	13 23·9				
		Sector E.				
1791.						
Jan. 4	12	6 19·4	1 9·0	182·4	0 14 23·49	0 14 26·65
	15	17 26·0				
7	12	8 18·6	3 9·8	181·2	22·85	24·93
	15	1 26·4				
14	12	3 8·3	15 23·7	181·0	25·79	25·54
	15	14 16·3				
19	12	10 5·0	4 18·7	181·2	27·32	25·48
	15	3 12·8				
20	12	10 6·6	4 19·6	181·9	27·44	25·28
	15	3 13·7				
27	12	14 7·0	8 17·6	181·4	30·23	26·00
	15	7 14·6				
31	12	4 2·0	16 12·7	181·1	30·38	25·05
	15	15 9·9				
Feb. 2	12	15 20·4	10 3·7	181·1	30·78	24·93
	15	9 1·3				

* 1790 December 6, the reading of the micrometer has been diminished from $17^r\ 26^d{\cdot}7$ to $16^r\ 26^d{\cdot}7$.

† 1790 December 22, the reading of the micrometer has been diminished from $5^r\ 23^d{\cdot}9$ to $4^r\ 23^d{\cdot}9$.

Date. 1791	Division.	Reading of Micrometer For Division.	For Star.	Nominal Seconds of Micrometer in Run over 3′.	Apparent Z.D. (Uncorrected for Refraction.)	Mean Z.D. for Jan. 0.
	′	r d	r d		° ′ ″	° ′ ″
Feb. 8	12	15 17·7	10 0·0	181·1	0 14 31·77	0 14 24·45
	15	8 25·6				
17	15	8 25·0	9 24·2	(181·8)	34·01	24·85
	15	8 24·5				
23	15	8 24 6	9 23·1	(181·8)	33·91	23·77
	15	8 22·9				
28	12	15 19·3	9 25·7	182·5	33·47	22 68
	15	8 25·8				
		Sector E.				
Sept. 10	12	5 3·3	0 20·1	181·9	0 13 56·97	0 14 25·06
	15	16 10·4				
11	12	5 5·5	0 21·1	183·2	57·31	25·46
	15	16 11·3				
12	12	5 5·4	0 23·1	179·7	57·50	25·70
	15	16 14·7				
13	12	5 7·0	0 21·7	183·1	58·26	26·51
	15	16 12·9				
14	12	5 6·2	0 20·8	181·7	59·27	27·56
	15	16 13·5				
15	12	5 7·5	0 23·1	181·2	58·61	26·93
	15	16 15·3				
16	12	5 7·0	0 20·8	181·0	60·53	28·88
	15	16 15·0				
18	12	5 9·0	0 24·5	181·0	58·84	27·23
	15	16 17·0				
25	12	5 8·7	0 24·0	180·5	59·37	27·73
	15	16 17·2				
		Sector W.				
Sept. 26	12	5 25·1	10 6·4	182·9	0 13 54·46	0 14 22·79
	15	12 19·0				
28	12	5 25·0	10 5·6	182·3	54·14	22·40
	15	12 18·3				
29	12	6 0·4	10 7·3	182·1	53·58	21·79
	15	12 20·5				
30	12	6 0·0	10 7·7	182·4	54·18	22·34
	15	12 20·4				

Date.	Division.	Reading of Micrometer For Division.	Reading of Micrometer For Star.	Nominal Seconds of Micrometer in Run over 3′.	Apparent Z.D. (Uncorrected for Refraction.)	Mean Z.D. for Jan. 0.
1791	/	r d	r d		° ′ ″	° ′ ″
Oct. 1	12	6 0·3	10 7·9	183·0	0 13 53·70	0 14 21·81
	15	12 21·3				
5	12	5 25·2	10 5·3	182·3	53·65	21·48
	15	12 18·5				
12	12	5 24·9	10 5·5	182·4	54·08	21·19
	15	12 18·3				
13	12	5 25·5	10 6·6	182·2	54·70	21·68
	15	12 18·7				
15	12	5 24·0	10 4·5	182·7	53·79	20·51
	15	12 17·7				
17	12	5 23·1	10 3·9	181·1	55·10	21·53
	15	12 15·2				
18	12	5 19·6	10 0·8	180·9	55·62	21·90
	15	12 11·5				
19	12	5 20·2	10 1·6	181·8	55·25	21·37
	15	12 13·0				
		Sector E.				
Oct. 23	12	14 23·4	10 11·0	178·5	0 14 1·41	0 14 26 84
	15	8 6·9				
24	12	14 22·5	10 7·8	180·6	2·29	27·54
	15	8 3·9				
27	12	14 24·8	10 9·3	182·1	2·08	26·75
	15	8 4·7				
Nov. 7	12	15 2·2	10 10·3	181·3	5·99	28·16
	15	8 9·9				
18	12	14 24·4	10 5·4	180·3	6·79	25·95
	15	8 6·1				
29	12	14 21·2	9 25·0	179·2	11·79	27·54
	15	8 4·0				
Dec. 28	12	14 22·1	9 18·7	180·1	18·32	23·72
	15	8 4·0				

On the Angular Distance of Two Stars in the Pleiades suitable for Determining the Value of a Micrometer Screw. By Professor H. H. Turner, M.A., B.Sc.

1. The following discussion was made in response to a request by Mr. H. F. Newall in 1895 February. He wrote: "I want to determine as accurately as possible the value of my micrometer screw, and have measured two stars in the *Pleiades* about 300″ apart. . . . Can you give me their accurate difference of Right Ascension? To determine this by transits would involve much labour." It is possible that the results of the investigation may be useful to others also.

2. A long series of photographs of the *Pleiades* was taken at this observatory in 1892–93, and some measures on three of these plates have been published (*Monthly Notices*, liv. p. 489). To give a better determination, however, twelve additional plates were measured, as described below.

3. The stars used by Mr. Newall are those numbered 33 and 44 by Elkin.* His numeration will be hereinafter adopted. They are numbered 34 and 45 by Jacoby.†

The second, but not the first, was measured by Bessel in 1840, and called Anon. 24; and again by Pritchard (*Mem. R.A.S.*, vol. xlviii.); but neither by Ambronn, of Göttingen, in 1894. Adopting the precessions and secular variations given by Elkin to bring up both his own and Jacoby's places to 1892·0 (the equinox used for the Oxford photographic measures), we find the differences of Right Ascension and Declination are as follows:—

	R.A.	Decl.
	′ ″	″
Jacoby	+4 50·13	+44·74
Elkin	+4 49·80	+44·75

The Oxford measures already published were made on plates taken on 1892 December 12, 13, and 1893 February 10 (*Monthly Notices*, liv. p. 489), and are expressed in rectangular coordinates on a tangent plane to the celestial sphere at *Alcyone*. It will be convenient to use these coordinates in what follows. The coordinates of the two stars on this plane with axes oriented for 1892·0, and expressed in *réseau* intervals (of 5′ of arc) are, according to Elkin's measures:—

* *Transactions of the Yale University Observatory*, vol. i., part 1, pp. 86 and 87.

† *The Rutherfurd Photographic Measures of the Group of the Pleiades. Observatory of Columbia College.* New York, 1892.